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A PROGRAM OF PHYSICAL EDUCATION INCORPORATING THE
DOMAN-DEACATO METHOD USED WITH TRAINABLE
MENTALLY RETARDED STUDENTS

A Thesis
Presented to
the Graduate Faculty
Central Washington State College

In Partial Fulfillment
of the Requirements for the Degree
Master of Education

by
Harold Wayne Johnson, Jr.
June 1969

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INTRODUCTION

Background and Review of Research

A majority of research compiled to date has pointed to the supposition that mentally retarded children are not equal to normal children in motor skills. In 1951, Sloan published a synopsis of his doctoral dissertation, which investigated the relationship between motor proficiency and intelligence. Two groups of subjects, matched for age and sex, one endogeneous mental defectives and one of normal intelligence, were administered the First Lincoln Adaptation of the Oseretsky Motor Development Scale. The following conclusions were gleaned from Sloan's research: (1) motor proficiency was found to be positively related to intelligence, (2) no sex difference was found, (3) with mental defectives, the degree of difficulty was found to vary directly with task complexity, (4) there were no significant differences on the Oseretsky between the "familial" and "undifferentiated" mental defectives. (Rabin 1957)

De Stefano et. al. (1958) stated that the literature suggests that "mental deficiency" is not only a reduction in intellectual functioning but a reduction in sensori-motor

abilities as well. In general, significant positive relationships have been reported, with comparisons between normal and defectives usually favoring the former.

Malpass (1960) designed a study to determine whether comparable groups of institutionalized and non-institutionalized retarded children could be differentiated on the basis of motor proficiency, and whether the motor ability of retardates would be distinguished from that of the normal children. In addition, the relationship between motor proficiency and intelligence for each group was investigated. His findings strongly confirm claims by others that motor proficiency is related to intellectual ability, at least in comparisons of mildly retarded and normal children. Highly significant differences were noted when retarded and normal children were compared, in favor of the latter group.

Howe (1959), using normal and retarded children (brain-damaged) in the public school setting, has furthered this research. His results show that normal children were consistently superior to mentally retarded children on eleven motor skill tasks. He asserts that the important issue for educators is to determine whether motor

performance of the mentally retarded can be modified by systematic instruction.

Kephart (1960, 1966) has approached this very task of systematic instruction and evaluation for motor skills. Roach and Kephart (1966) concur that the child's first interactions with his environment are motor. His first learnings are motor learnings. His first attempts to organize the environment are based upon these motor interactions. For a very large number of children, the learning difficulty begins at this early motor stage. He learned to use his motor responses to accomplish certain ends, but he failed to expand or generalize these motor responses so that they formed the basis of information gathering. He has learned a motor response for a specific end, but has not developed a motor interaction with his environment.

Kephart further suggests that it is logical that all behavior is basically motor, that the prerequisites of any kind of behavior are dependent upon lower forms of behavior, thus making even these higher activities dependent upon the basic structure of the muscular activity upon which they are built. In order to help the child who is in difficulty, it is necessary to identify the stage at which learning

failed, to supply the necessary learning, and to assist him in more advanced stages of development which now become feasible on the basis of the new learning. For a child in whom some of the physiological and neurological processes necessary for such learning do not operate normally, it becomes impossible without very special help.

Theory of Neurological Organization

Delacato (1959), after three intensive years of studying the different approaches, came to the conclusion that none could answer the question of treatment of reading problems or the problems of mobility. Delacato studied under the late Temple Fay, professor of neurosurgery at Temple University School of Medicine. Through his research under Fay, Delacato brought the fields of neurology and education together in his thinking about learning problems. Fay had recognized that most brain injuries did not involve the destruction of all cells in the injured area. He had suggested that it might be possible to activate the millions of surviving cells to take over the function. Fay also studied the origin of human movement, its inter-relationship with phylogenetic, ontogenetic and neurological

development of man.

On the bases of these years of research and study, Delacato formulated his own concept of treatment and has expressed it in his Neurological Organization: (Delacato, in Delacato 1966)

... neurological organization is the physiologically optimum condition which exists uniquely and most completely in man, and is the result of a total and uninterrupted ontogenetic neural development. This development recapitulates the phylogenetic neural development of man and begins during the first trimester of gestation and ends about six and one-half years of age in normal humans. This orderly development in humans progresses vertically through the spinal cord and all other areas of the central nervous system up to the level of the cortex, as it does with all mammals. Man's final and unique developmental progression takes place at the level of the cortex and it is lateral (from left to right or from right to left).

This progression is an interdependent continuum, hence if a high level of development is unfunctioning or incomplete, such as in sleep or as the result of trauma, lower levels become operative and dominant... If a lower level is incomplete, all succeeding higher levels are affected both in relation to their height in the central nervous system and in relation to the chronology of their development.

The basic premise of the neuro-psychological approach, is that if man does not follow this schema he exhibits a problem of mobility or communication. To overcome such problems one evaluates the subject via the neurological schema. Those areas of neurological organiza-

tion which have not been completed, or are absent, are overcome by passively imposing them upon the nervous system in those with problems of mobility... When neurological organization is complete the problem is overcome. (Pp. 6-7)

Lewin (1968) adds meaning to the above statements in an article titled, "Neurological Organization, The Gap Between Potential and Capability."

The potential of the normal organism is neither observable nor measurable... Under these circumstances it would be unwise to make assumptions as to the potential of the neurologically dysorganized person. However, on clinical grounds (Doman et. al. 1960) it would appear that severely brain-damaged children may achieve heightened capabilities in mobility on a program of environmental enrichment... Such potential as exists in the neurologically dysorganized child must reside in the surviving but functionally depressed or undeveloped cerebral tissue which might conceivably be raised to effective levels of action. The means whereby this could be accomplished must be the same basic physiological development process which would have advanced the child's capabilities if he had not sustained brain injury... If the normal child requires interaction

with the environment for his capabilities to evolve, if maturation alone does not suffice, it becomes apparent that the child with an injured brain requires an exceptionally and purposefully enriched environment in order to achieve his potential, whatever it may be.

Morris (1968), investigating the reading process and its relationship to neurological organization, contends that the reading problem is basically of a dual origin. Eyes, if properly developed by nature's regimen, should fuse on their target, whether it be in space or whether it be in a line of print. A child does not come into the world with the capacity to converge or fuse his eyes. He must develop it. This capacity is developed naturally by a young child when he creeps on his hands and knees... This creeping is highly beneficial experience and if one is deprived of it he is considerably bereft.

While creeping a youngster develops stereoptic capacity as he watches his forward hands alternate before him. He develops his tactility as he brushes with the floor. He develops his depth perception as he measures distance on his journey. He acquires balance. But above all, he is developing one of the vital layers of the brain--the mid-brain...

When a baby flails in his crib, crawls on his stomach, creeps on his hands and knees and walks in cross pattern, he sequentially develops the respective layers of the brain and then goes on to achieve the cortical hemispheric dominance... Nature's ukase is that you must traverse this developmental pathway or else you will sustain a degree of underdevelopment commensurate with the omission or deprivation.

However, bountiful nature gives a reprieve. If you miss the developmental experience, the first time around, you can perform belatedly and with good results.

The Institutes for the Achievement of Human Potential are now committed to a significant increase in the ability of all children to perform in the physical, intellectual and educational realms... Studying children who are lacking developmentally has led to the conclusion that most of the developmental lags are directly correlated with similar lags in development of nervous system... When significant numbers of brain-injured children had been raised to average brain levels, it became apparent that the process of neurological maturation can be speeded as well as delayed and that his speeding can be accomplished by certain simple

nonsurgical procedures. (Doman and Delacato, 1968)

Doman, Spitz, Zucman, Delacato, and Doman (1960) implimented the concept of neurological organization with seventy-six brain injured children in treatment of their mobility deficiencies. The seventy-six children were those seen in the children's clinic during the study period.

Each child was given a thorough neurological examination and the disabilities determined in functional terms. An outpatient program of neurological organization was then prescribed and taught to the parents. The parents were required to carry out the program exactly as prescribed. Two types of treatment were used: Type I was used with all nonwalking children. This treatment consisted of requiring the children to spend all day on the floor in the prone position with encouragement to crawl or creep when that level of accomplishment was possible. Type II treatment was prescribed to children commensurate with their level of development. A specific program of activity was prescribed which passively imposed on the central nervous system the functional activity which was normally the responsibility of the damaged brain level... The children were patterned for five minutes, four times daily, seven days a week without

exception. The patterns were administered by three adults... This treatment consisted of homolateral patterning exercises and cross pattern exercises.

Results of this program of treatment found significant improvement when compared to results of classic procedures which they had previously followed. It was their stated opinion that the significance of the difference tends to corroborate the validity of the hypothesis set up as the theoretical basis of the program.

Doman and Thomas (1966) presented results of their work with 335 brain-injured children. These were children which had been seen over the past dozen years at the Institute for Achievement of Human Potential. The treatment and procedures used with these children were those basic to the concepts and philosophy of neurological organization. The results of treatment follows: ...the mean rate of neurological growth of the 335 patients prior to treatment was approximately $\frac{2}{5}$ that of slow normal development as indicated on the profile (Doman-Delacato profile) at the close of the study, 290 (86.6%) showed improvement in their rate of neurological growth and 45 (13.4%) showed improvement in rate even though most of them showed some

improvement of functions in keeping with their chronological and maturational development.

Physical abilities and reading abilities in terms of mobility and learning behavior were posited to be coupled with the neurological organization of the organism and the degree to which neurological organization is complete. It is this relationship which leads one to hypothesize that it is possible to remediate neurological deficiencies by imposing on the organism, either directly or passively, those exercises—perceptual and physical—that the child has skipped or missed during the sequence of development.

Research Pertaining to the Validity of Neurological Organization

Three studies in recent literature have found questionable the validity of the neurological organization approach. These studies relate to both normal and retarded children in the public school setting.

Kershner (1968) researched the Doman-Delacato theory as it applies to trainable mentally retarded children. The purpose of his investigation was to determine the effects of a structured program of physical activities upon the

physical and intellectual development of trainable mentally retarded children. His null hypotheses were: (1) no significant differences would develop in creeping and crawling improvement between the experimental and control groups, (2) no significant differences in motor proficiency improvement would develop between the experimental and control groups, and (3) no significant difference in mean I.Q. improvement would exist between the experimental and control groups.

The statistical tests performed led to the following conclusions: (1) results of hypothesis I support the basic assumption that creeping and crawling performance improves through participation in creeping and crawling activities. Neurological organization, however, implies a concomitant change in cognitive functioning not simply improvement in creeping and crawling. The results of hypothesis II did not support an explicit contention that recapitulation of early perceptual motor developmental sequences is prerequisite to the performance of more sophisticated perceptual motor skills that are not practiced. Results of hypothesis III tend to support the Doman-Delacato theoretical position.

Caution is suggested in interpreting these results on the bases that they could be affected by the degree that covariance analysis is inferior to randomization, and the unknown extent to which improvement may have been due to factors associated with initial group differences.

Robbins (1966) investigated the validity of Delacato's theory with normal children from three schools selected from the Chicago Roman Catholic Archdioces. All children were enrolled in the second grade and were picked by the principal of each school. The experimental group underwent a three month program that emphasized cross-pattern creeping and walking, avoidance of music and use of specified writing position. The group experienced nearly two months of emphasis on use of the appropriate sleep position and of sideness and cross-patterning activities. Homolateral patterning and color-filtration activities were carried out for approximately one month. The nonspecific group was subjected to three months of nonspecific patterning activities, musical activities, and games and was encouraged to listen to music independently. Subjects in the nonspecific group were exposed to a nonspecific sleep position for two months and to the nonspecific color

filtration program for one month.

The six null hypotheses of the study were chosen to test the basic assumptions of the theory of neurological organization and its practical aspects. The fact that the theory was not supported by any of the findings casts doubt upon its practicability and validity.

Robbins (1967) examined further the neurological organization approach as it related to retarded readers. One hundred and forty-nine children were taken from grades three through nine of several schools in the Chicago area which held summer reading programs. The control group carried out its normal curriculum. The experimental group was subjected to a program described by Delacato in addition to its regular curriculum. A third group identified as nonspecific was subjected to a general program of activities, not known to be correlated with reading achievement, in addition to its normal curriculum.

The null hypotheses tested were: (1) reading is not related to creeping, (2) reading is not related to laterality, and (3) reading improvement is not related to exposure to the experimental or nonspecific program. None of the three null hypotheses could be rejected on the bases of

data gathered in the study. These findings led to the following conclusions applicable to the retarded readers who participated in the investigation: (1) the data did not support the postulated relationship between neurological organization (as measured by creeping and laterality) and reading achievement... and (2) the data from the study did not support the contention that the addition of the Delacato program to the ongoing curriculum of the retarded readers in any way enhanced their reading development when compared to similar children not exposed to the experimental program.

Problem and Purpose

Evidence suggests (Howe, Sloan, Rabin, Malpass and De Stefano et. al.) that motor proficiency of mental defectives falls below that of normal children. The evidence presented points also to the intellectual involvement that is related to motor proficiency.

Kephart has stated that the basis of learning is predicated on motor development, without which, the child experiences faulty perceptions of his environment. The child's ability to structure his environment through his motoric behavior is paramount to his understanding of his

relationship to it. The child who finds himself physiologically or neurologically below normal lacks many of the spontaneous abilities to search and relate to his environment. He is, in effect, "retarded" in his abilities to lay the foundations necessary for later learning. The questions for educators become, what types of learning experiences can be used to remediate such motor deficiencies, how should they be applied, and at what level of the organism's development do we approach the problem?

The present study reports on a physical education program which was used with trainable mentally retarded children. Incorporated into this physical education program were those exercises advanced by Delacato. The neurological organization exercises were done, for a ten minute period daily by a group of students, in determining if they had any significant effect on the physical abilities or reading abilities of these students. The test results of the students participating in the neurological organization exercises are compared to the test results of a group of students receiving a conventional physical education program and to the test results of a group of students receiving no structured physical education program. The results were

determined by examination of the scores received from administration of the Slosson Oral Reading Test, the Wide Range Achievement Test (reading sub-test only), and the Metropolitan Toronto Association Test of Physical Fitness before and after the eight-month Delacato program.

It was the intent of this study to further investigate the position of neurological organization as it pertains to the remediation and/or cure of mobility and communication problems of trainable mentally retarded children. It is, in part, directed toward answering Howe's implication for educator's in deriving a systematic approach to instruction for motor skills with the mentally retarded.

Hypotheses

Null hypothesis I: It was hypothesized that those students receiving Doman-Delacato exercises ten minutes daily for eight months would show no significant improvement in reading ability as compared to the two control groups. More explicitly stated in two subhypotheses, (a) no significant increment would occur in Slosson Oral Reading Test (SORT) scores and (b) no significant increment would occur in the reading subtest scores of the revised edition of the

Wide Range Achievement Test (WRAT) of the experimental group as compared to the two control groups.

Null hypothesis II: It was hypothesized that those students receiving the Doman-Delacato exercises would show no significant improvement in physical ability as compared to the two control groups. The selection of the Metropolitan Toronto Association Test of Physical Fitness was made to assess physical ability because its standardization was established with mentally retarded children. The selection was due also to its containing eight sub-tests of physical ability, giving it the breadth necessary in measuring each child's particular abilities.

METHOD

Subjects

The subjects were selected from the Grand View School for Trainable Mentally Retarded Children, Kent School District, Kent, Washington. The subjects comprised the four higher age groups of students at Grand View School. Their ages ranged from ten to twenty years. The subjects were selected and assigned to three groups according to age, physical ability and class level. Children with limiting congenital heart diseases and/or cerebral palsy were not included in the study. The experimental group (E) was composed of those students in advanced class two and intermediate class one at Grand View School, ages 10-20. Control group one (C_I) was composed of those students in advanced class one, ages 11-17. Control group two (C_{II}) was from advanced class three, ages 12-19. The final selection of subjects in each group was: E - 24, C_I - 10, and C_{II} - 12. (Table 1)

Design

A multi-group design was employed, the E group received the independent variable, C_I group received a

TABLE 1
CHARACTERISTICS OF GROUPS

Group	\bar{X} Age in years	\bar{X} IQ
Experimental:		
Boys	15 (N = 18)	47 (N = 17)
Girls	14 (N = 6)	41 (N = 6)
Control I:		
Boys	13 (N = 2)	57 (N = 2)
Girls	14 (N = 8)	56 (N = 7)
Control II:		
Boys	16 (N = 5)	48 (N = 5)
Girls	17 (N = 7)	39 (N = 6)

nonspecific program, and the C_{II} group was a classical control group.

C_{II} participated in a regular school program and received no structured physical education program for the duration of the study. C_I participated in a program of physical education designed to allow the students to experience calisthenics one hour per week, and game-type activities for one-half hour per day. The E group received a structured physical exercise period for one hour per week, plus game-type activities for one-half hour daily. In addition to this program, the E group received ten minutes of Doman-Delacato exercises daily, consisting of three months of cross-pattern crawling, three months of cross-pattern walking. These latter exercises were followed in accordance with Doman-Delacato exercises as presented in a pamphlet by Systems for Education, Inc., titled "Neurological Organization in the Classroom: a handbook for teachers and supervisors who are involved in treating reading problems." (Appendix A)

Procedure

All students in the study were pre-tested with the

following instruments during the first month of the academic school year 1967-1968: The Wide Range Achievement Test (WRAT), reading sub-test only; Slosson Oral Reading Test (SORT); and the Metropolitan Toronto Association Test of Physical Fitness. The WRAT and SORT were administered individually, in accordance with the directions in the respective test manuals. The physical fitness test was administered in groups, where designed to handle groups. The physical fitness test was broken into three groups of exercises. This was done to prevent fatigue from one test influencing another.

The E group received approximately eight months of neurological organization exercises. The first week of each part of the program was designed to teach the students the correct methods in crawling, creeping, and walking. (Appendix A) After completion of this initial training period, the students entered the physical education room, removed their shoes and commenced crawling, creeping, or walking for ten minutes. The period for this activity was fifteen minutes in length, allowing time for the removal and putting on of shoes. In addition to the above program, the E group participated one hour per week in a physical

exercise period. (Appendix B) This consisted of calisthenics appropriate for trainable mentally retarded students.

CI and E both participated at different periods in this physical exercise, both of these groups participated together during the game type activities, which consisted of sport activities.

At the conclusion of the eight-month period, all students were tested on the instruments given at the beginning of the program.

RESULTS

The intent of this study was to determine the effect that neurological organization exercises (Delacato 1966) would have on the reading and/or physical abilities of trainable mentally retarded students. Statistical data was collected through the examination of the pretest and post-test results on three instruments, the WRAT, SORT and the Metropolitan Toronto Association Test of Physical Fitness. Statistical tests were used to determine the degree to which differences might be attributable to the independent variable or to sampling error or chance. Significance for the rejection of the null hypothesis was set at $p \leq .05$.

The Kruskal-Wallis H Test for k Independent Samples was used to determine if differences existed between the groups on the pretests, post-tests, and post-minus pretests in each area tested. Significant differences were found between the groups on six measures, significance being accepted at the $p = .05$ level, $H \geq 5.99$. The differences between groups on the pretests were on the SORT reading test and vertical jump subtest of the physical fitness test. Differences on the post-tests were found between groups on the SORT, and

WRAT reading tests. Differences between groups on the post-minus pretest were found on the 300 yard run and vertical jump of the physical fitness tests. The Kruskal-Wallis H test identified those tests where there were differences great enough between the three groups to reject the null hypothesis that they were from the same population (Table 2). The direction of difference was not considered in analysis by the Kruskal-Wallis H test. This lack of identification of the direction of change and between which groups change occurred, necessitated the use of the Rank Test for Two Independent Samples. This test compared each of the three groups on all tests given, 1 to 2, 1 to 3, and 2 to 3 showing the direction of difference. The results of this analysis yielded a (z) score which was significant at the $p=.05$ level, $z \geq 1.96$ and $p=.01$ $z \geq 2.59$ for a two tailed test. The significance of $p \leq .05$ magnitude was accepted as grounds for rejecting the null hypothesis and accepting the alternate hypothesis that the groups were from different populations. A (z) of significance between groups on the post-test minus pre-test is an indicator of the difference or gains for that particular group over the other groups during the eight-month period on the test indicated. Significant

TABLE 2

KRUSKAL-WALLIS H TEST

Indicating where rank differences
exist between groups

Test	Pre-test	Post-test	Post Minus Pre
SORT	10.21*	9.37*	3.30
WRAT	2.87	7.87*	4.61
300 yard run	.30	3.94	10.27*
Back extension	1.09	2.22	.92
Floor touch	.94	2.36	1.52
Medicine ball throw	.35	.67	1.87
Hang	.42	1.16	.60
Speed back lifts	5.46	2.59	.59
Sit-ups	5.33	5.90	1.53
Vertical jump	6.32*	.85	18.94*

Note.—* denotes a significant difference between groups on that test. For a two tailed test H is significant at $p=.05$, when $H \geq 5.99$. When H is found to be equal or greater than 5.99 we may reject the hypothesis that the samples are from the same population.

gains were found on one test, the WRAT (reading sub-test), between the E group and C_{II}: $z=2.05$ significant at the $p=.05$ level (Table 3). This significant gain in reading ability by the E group, which received the Doman-Delacato exercises, as measured by the WRAT is somewhat confounding when related to null hypothesis I, which states that there would be no significant differences between groups in their reading ability. On the basis of statistical analysis of the WRAT, sub-hypothesis (b) of null hypothesis I is rejected, but the WRAT was representative of only one-half of the measure of reading ability. Sub-hypothesis (a) of null hypothesis I is accepted with relation to the SORT.

A Sign Test for Two Correlated Samples was used to determine the gains between pretest and post-test data by each group on each test. No significant gain scores were made on either of the reading tests by the three groups (Table 4). A further comparison of mean raw scores between pretest and post-tests on the two reading tests by each group showed that there were mean gains made by the E group on the WRAT, C_I showed gains on the SORT and WRAT and C_{II} group showed no mean gains (Appendix C).

TABLE 3

RANK TEST FOR TWO INDEPENDENT SAMPLES

(Comparing groups in pairs)

Test		E	C _I PRE-TEST	C _{II}	E	C _I POST-TEST	C _{II}	E	C _I POST MINUS PRE	C _{II}
SORT	E		-0.53	2.72*		-0.90	2.24*		-1.66	-0.72
	C _I	0.53		3.05*	0.90		3.24*	1.66		1.28
	C _{II}	-2.72	0.53		-2.24	-3.24		0.72	-1.28	
WRAT	E		.49	1.48		-.30	2.27*		-1.90	2.05*
	C _I	-.49		1.50	.30		2.82*	1.90		1.64
	C _{II}	-1.48	-1.50		-2.27	-2.82		-2.05	-1.64	
300 yard run	E		.25	.18		-1.47	-1.70		-2.76	-2.37
	C _I	-.25		-.92	1.47		.43	2.76*		.63
	C _{II}	-.18	.92		1.70	.43		2.37*	-.63	
Vertical jump	E		1.66	2.21*		-.95	.03		-3.55	-3.51
	C _I	-1.66		1.11	.95		.63	3.55*		.07
	C _{II}	-2.21	-1.11		-.03	-.63		3.51*	-.07	
Speed sit-ups	E		1.11	2.23*		.76	2.09*		-.52	.66
	C _I	1.11		1.06	-.76		2.22*	.52		1.47
	C _{II}	-2.23	-1.06		-2.09	-2.22		-.66	-1.47	

TABLE 3 (Continued)

Test		E	C _I	C _{II}	E	C _I	C _{II}	E	C _I	C _{II}
		PRE-TEST			POST-TEST			POST MINUS PRE		
Speed	E		1.38	2.12*		.95	1.58		-.57	-.66
Back	C _I	-1.38		1.13	-.95		.66	.57		-.20
Lifts	C _{II}	-2.12	-1.13		-1.58	-.66		.66	.20	
Medicine	E		-.49	.07		.55	.72		.66	1.36
Ball	C _I	.49		.60	-.55		.27	-.66		.43
Throw	C _{II}	-.07	-.60		-.72	-.27		-1.36	-.43	
Floor	E		.94	-.05		1.33	1.14		1.07	.92
Touch	C _I	-.94		-.75	-1.33		-.10	-1.07		-.03
	C _{II}	.05	.75		-1.14	-.10		-.92	-.03	
Hang	E		.06	.46		.06	1.00		.74	.34
	C _I	-.06		.79	-.06		.86	-.74		-.46
	C _{II}	-.46	-.79		-1.00	-.86		-.34	.46	
Back	E		.95	.76		1.51	.71		.82	.24
Extension	C _I	-.95		.23	-1.51		-.53	-.82		-.93
	C _{II}	-.76	-.23		-.71	.53		-.24	.93	

Note.—* denotes a significant difference between pairs. For a two tailed test (z) is significant at $p=.05$ when $z \leq 1.96$. A significance found between post minus pre-equals a gains difference. When (z) is found to be significant we may reject the null hypothesis that the samples came from the same population.

TABLE 4

A SIGN TEST FOR TWO CORRELATED SAMPLES

Comparing pre-test to post-test scores

Test .	Group	Prob.	Test	Group	Prob.
WRAT	E	.480	300 yard	E	.016*
	C _I	1.274	Run	C _I	.344
	C _{II}	1.876		C _{II}	1.854
SORT	E	1.942	Medicine	E	.524
	C _I	1.000	Ball	C _I	1.820
	C _{II}	-----	Throw	C _{II}	1.890
Floor	E	.454	Hang	E	.832
Touch	C _I	1.624		C _I	1.656
	C _{II}	1.000		C _{II}	1.000
Speed	E	.026*	Speed	E	.184
Back	C _I	.180	Sit-ups	C _I	.290
Lifts	C _{II}	.004*		C _{II}	1.960
Back	E	.832	Vertical	E	1.546
Extension	C _I	1.930	Jump	C _I	.022*
	C _{II}	1.000		C _{II}	.012*

Note.—* denotes a significant gain between pre-test and post-test scores, $p \leq .05$.

Null hypothesis II was accepted since no differences between groups were found (Table 3). Each of the eight subtests were analyzed statistically by the Rank Test for Two Independent Samples. Further analysis of the physical fitness subtests was made to ascertain the individual gains of each group on each physical fitness subtest. The Sign Test for Two Correlated Samples was used to compute the differences between pretests and post-tests of each group. Rejection of the null hypothesis was made at the $p=.05$ level. These results show that there were gains in ability over the eight-month period by the E group on the speed back lifts, $p=.026$ and the 300 yard run, $p=.016$. C_I and C_{II} both made significant gains on the vertical jump sub-test, $p=.022$ and $p=.012$ respectively (Table 4).

DISCUSSION

Examination of the results do not indicate complete support for the hypotheses, but the trend of the data is positively skewed in that direction. That is, there were no significant differences found between the control groups and the experimental group on each of the eight measures of physical ability and no significant differences were found on one of the reading tests. These statements must be made cautiously, however, because of the significance in gains of the experimental group on the one reading test of null hypothesis I.

Sub hypothesis (b) of null hypothesis I was rejected. The experimental group did perform significantly better on the reading sub-test of the WRAT than did $\underline{C_{II}}$, but not significantly better than $\underline{C_I}$. There were no differences between groups in reading ability as measured by the SORT. The important aspect of the significance of the difference found between the experimental group and control group II is in the degree of significance obtained. Results indicate that when the three groups were considered together there were no differences between them, but when compared to each other,

respectively, a difference is obtained between the experimental group and control group II. The difference found when these groups are compared individually and not as a total may be interpreted as reflective of the statistical analysis used in interpretation of the data. Statistically, inferences drawn from data which are analyzed by rank order methods should be interpreted cautiously. The use of such statistical tests do not consider the possible differences of variability between groups. Inherent in the use of non-parametric measures is that they make few assumptions about the properties of the parent distributions, thus limiting their power efficiency.

The acceptance of sub hypothesis (a) of null hypothesis I lends support to the results obtained by Robbins (1966, 1967). His data did not support the postulated relationship between neurological organization and reading achievement. Robbins' conclusions point to the crucial relationship between reading ability and the Delacato theory. Central to the concept of Delacato's theory and its application is the notion that neurological organization can be measured by behavioral tasks and that reading can also be used as a clinical index of the quality of neurological organization.

The rejection of sub hypothesis (b) of null hypothesis I supports the supposition that neurological organization and reading are related. The significant difference found between the experimental group and control group II may be explained in part by limitations in the design of the study. The factors of selection and the nature of the population used may have had direct influence on the rejection. Selection of students by age, physical ability, and class assignment did not allow for random selection or random assignment of students to groups. The initial differences between students and the rate of progress before the initiation of the program could not be controlled. One might hypothesize that these initial differences coupled with the rate of maturity and teaching methods used by each teacher may have influenced the final results. With the data at hand, it is impossible to isolate these sources of difference.

The differences found between these two groups may also be reflective of the structure and standardization of the two reading tests employed. The Slosson Oral Reading Test required only sight recognition of words as an indicator of reading ability level. The Wide Range Achievement Test (reading sub-test) required sight recognition of words,

sight recognition of single letters and sight matching of individual letters as a measure of reading ability level. Standardization of both of these instruments was established with normal populations.

Robbins (1966) lends support to yet another aspect of the differences due to selection of subjects. The theory of neurological organization was developed from evidence gathered from brain-injured children and those with reading problems. In applying this approach to a wide range of etiologies and learning problems one takes the chance of using the approach with children not used in studies substantiating the theory. Delacato (1968), however, has purported that his approach can be used effectively with all children.

Null hypothesis II was accepted, no differences between groups were found in physical ability as measured by the eight sub-tests of the physical fitness test. In terms of mobility the acceptance of null hypothesis II is in conflict with Delacato's (1968) study, which when analyzed globally yielded significant gains in mobility for fifty-one per cent of the children in his study.

The results of hypothesis II may also be interpreted

in part to add further support to Kershner's (1968) null hypothesis that there would be no significant differences in motor proficiency developed between the experimental and control group. Kershner found that similar improvement could occur through another type of physical activity program. In the present study, Kershner's statements are given support. As the results indicate, not only will another program of physical activity bring about similar improvement, but a program offering no structured physical activity program has shown substantial improvement.

The amount of research directed toward the positive validation of the Delacato approach is sparse. At present, Kershner (1968) and Robbins (1966, 1967) are the only persons, not associated with Delacato, who have published research studying the validity of his theory as it applies to school children. Both of these men have found the validity of such an approach questionable and warn that caution should be taken in accepting the Delacato rationale of neurological organization.

In June, 1968, a statement was prepared by the Committee on The Handicapped Child. Among those approving the statement were the Executive Board of the American Academy

of Pediatrics, the National Association for Retarded Children, the American Association on Mental Deficiency, the American Academy for Cerebral Palsy, and the Canadian Association for Retarded Children. This statement presents reasons for concern and statements directed toward the validity of the Delacato theory. Their statement in essence was, "There is no empirical evidence to substantiate the value of either the theory or practice of neurological organization..."

Freeman (1967) in reviewing the controversy over patterning and the Delacato rationale contends that a study which would settle all aspects of controversy regarding effectiveness of the program is probably impossible to design and carry out at this time. He recommends that physicians and other professionals should weigh carefully the recommendations of such treatment. It is concluded, however, that a major source of negative professional feeling has been the inappropriate publicity given to claims of results which have not been documented or supported in a scientific manner.

The present study has addressed itself toward researching the validity of the Delacato approach of neurological

organization as it applies to trainable mentally retarded school children. The lack of significant differences between groups on the physical fitness tests requires questioning the validity of such an approach. Equally, the partial significance in reading ability obtained by rejection of sub hypothesis (b) of null hypothesis I, does not merit total acceptance of this rationale for trainable retarded students.

In light of the present programs for trainable retarded students, it seemed appropriate that some further investigation of Delacato's theory be made. A theory which contends that it can increase reading and physical ability levels of retarded children merits consideration and investigation of its claims. The present study has directed itself towards these ends. It is hoped that the findings contained in this study will lead to further questioning, and systematically controlled investigations of the neurological organization theory as it pertains to trainable mentally retarded students.

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APPENDIX A

APPENDIX A

INITIAL TRAINING PROCEDURES FOR CRAWLING, CREEPING, AND WALKING EXERCISES

All of the procedures were preceded with demonstration by the instructor.

Crawling (Cross-pattern)

1. The student layed flat on his stomach on the mat. He was instructed to:

- a. extend his right leg back, away from his body, bringing his left knee up to his body.
- b. extend his right arm forward, drawing his elbow along the mat, and to extend his left arm and elbow back toward his body.
- c. turn his head toward the side of the forward arm.
- d. repeat steps a and b using the opposite leg and arm.

2. The combination of the above movements resulted in the student pulling himself along the mat on his stomach.

3. The important facet of these instructions is in the movement of the opposite arm and leg in unison.

Creeping (Cross-pattern)

1. The student was directed to assume a position where he was on his hands and knees on the mat. The first goal was to teach him to creep so the opposite knee and hand hit the mat at the same time. This process is the same as that required for the crawling procedure. The important aspect again being that the opposite leg and arm should be in unison.

2. Steps used to refine the procedure were:

- a. have the student turn his head slightly toward that hand which is forward.
- b. have the student place his palms flat on the floor.
- c. have the student be sure that his opposite knee and hand are off the mat as he creeps.
- d. have student keep knees approximately twelve inches apart.
- e. have student keep toes dragging on mat at all times.

Walking (Cross-pattern)

1. Have the student stand with his feet approximately twelve inches apart. He should be instructed to first move his right foot forward, pointing toward this foot with his left arm, turning at the waist. This procedure is then repeated for the left foot and right arm.

2. Again the important facet of this procedure is to help the student move his opposite leg and arm in unison.

3. As the student masters the concept of walking he may proceed faster and eliminate pointing at the forward leg with his hand.

4. The walking motion should look natural.

After these initial procedures the instructor watched each student and corrected any errors in patterns.

APPENDIX B

APPENDIX B

EXERCISES USED WITH THE E GROUP

AND C_{II} GROUP

Physical exercises designed to develop physical fitness, deleting any specific patterns of exercises:

1. Simple games.
 - a. copy me, hand position exercises
 - b. eye movement exercises—without movement of head
 - c. head movement, stretching neck muscles
 - d. standing on one foot—alternating feet
 - e. body schema exercises—copy me exercises
 - f. running in place
2. Calisthenics.
 - a. touch toes
 - b. jumping jacks
 - c. sit ups
 - d. leg raisers
 - e. cross touch toes
 - f. jumping on toes
 - g. walking while sitting
 - h. trunk rotators
 - i. side benders
 - j. running—three minutes
3. Circle games and ball games in-doors.
4. Mat exercises.
 - a. somersaults
 - b. rolls
 - c. standing on head
 - d. backward somersaults
 - e. running somersaults

APPENDIX C

APPENDIX C

MEAN RAW SCORES OF PRETEST AND POST-TESTS

GROUP	SORT	WRAT	METROPOLITAN TORONTO PHYSICAL FITNESS SUBTESTS								
			Back Exten	Speed Back Lifts	300 Yard Run	Vert Jump	Medic Ball Throw	Hang Time	Speed Sit Ups	Floor Touch	
E	PRE	1.80	1.705	13.85	19.29	129.50	6.68	11.00	26.45	12.46	4.30
	POST	1.64	2.730	14.21	22.58	117.71	5.75	12.63	31.26	12.54	5.30
C _I	PRE	1.21	1.477	11.40	13.10	120.30	4.75	10.94	30.20	10.60	3.40
	POST	1.23	1.620	10.20	19.50	133.10	7.35	10.88	31.38	11.20	3.00
C _{II}	PRE	.158	.727	10.88	9.08	130.60	3.50	11.01	27.17	7.95	4.45
	POST	.125	.701	11.71	15.75	141.33	6.00	10.43	26.38	7.85	3.75